NATIONAL ENGINEERING ROBOTICS CONTEST 2024

THEME: INDIGENOUS CATEGORY

National Engineering Robotics Contest

A joint venture of NUST and STEM Careers Programme (HEC) Organized

by:

Department of Mechatronics Engineering,

College of Electrical and Mechanical Engineering (CEME),

National University of Sciences and Technology (NUST), Islamabad, Pakistan &

National Centre of Robotics and Automation (NCRA)

CHANGE LOG

The table below will list the pages on which changes have been made to the theme.

Revision Date	
11-Mar-2024	Page 8, Figure 1(a): Correction on Starting Line and Rock Position Map
11-Mar-2024	Page 8, Figure 1(b): Correction on Starting Line
18-Mar-2024	Section 4 point 17, Table 6.1 and section 7.3.
14-May-2024	Annex A-Addition of Tree/Rock Images (Fig. 5)
22-May-2024	Addition of combinations of Rock Position Map + Images of Rock Position map plates (Fig. 2-4)
22-May-2024	Section 4 point 4, 8 and 13.
14-Jun-24	Match duration changed from 3 minutes to 4 minutes

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NOTE:

1. Any correspondence with the NERC officials via e-mail, telephone, or any other means will not be considered as part of the rules (unless uploaded as an FAQ on official NERC website).
2. In all matters of interpreting the rules before and during the Contest and in any issues not covered by these rules, the decisions of the Contest Judging Committee will be considered final.

CONTENTS

1 INTRODUCTION

The National Engineering Robotics Contest (NERC) is a joint project of the National University of Sciences and Technology (NUST) and Science Technology STEM Careers Program HEC to promote research in the field of robotics and its related fields in Pakistan. We, from the Department of Mechatronics Engineering, welcome you all to participate in 20th National Engineering Robotics Contest (NERC 2024). This competition will provide a common platform for the integration and evaluation of various electromechanical designs, control and path planning algorithms, and agent architectures.

Over the years, NERC has grown increasingly popular among students as well as engineering departments across the country. The Engineering students from all over Pakistan participate in this competition. Many students participate in this contest in their final years of undergraduate degree and take the contest theme as their Final Year Project, thus becoming part of human resource required in field of robotics and automation. This not only adds value to the competition but also resolves our pledge to bring exciting new challenges every year for the advancement of robotics community at an increasingly wider scale. Robotics is a buzz word at today's technology forefronts. Due to exponential advancements in fields like high performance computing, computer vision, computer networks, material sciences and power electronics, the growth experienced by robotics in past few years is unprecedented. Robotics is the only field which can add precision while replacing the slow manual labor in the contemporary industrial world. Thus, this field faces enormous pressure from industry to produce all-purpose mobile manipulator robots which can perform complex tasks like grab, navigate and place objects at desired locations autonomously. The future of Pakistan relies heavily on advancement in the fields of engineering and science, events of this nature will encourage and motivate students to improve their technical skills in leaps and bounds. The focus of NERC 2024 theme is to create an autonomous robot that can automate tree plantation drive. In this theme, the robot's task is to prepare the soil for plantation by removing any rocks, garbage etc. present in the soil and then planting a tree at defined locations in the field. The first team to successfully complete the task and reach the finish line will be declared "**The Winner**".

2 CATEGORIES

There are two categories of the contest:

- Indigenous Robot category
- Modular Robot category

The purpose of this contest is to develop a sense of problem-solving, project- based learning, team-based learning, technical design, and ingenuity among the contestants.

2.1 INDIGENOUS ROBOT CATEGORY

Indigenous category includes robots that are constructed from scratch. Their mechanical structure, controls etc. are designed by the teams themselves. The electronic control modules including all electronic boards and motor drivers (unless specified otherwise) etc. should be designed and manufactured by the students.

2.2 MODULAR ROBOT CATEGORY

Modular/Lego category includes robots that are developed using ready-made kits for example Lego, EV3 kits, EDVON kits or NCRA robotic kit. The Modular category is further divided into two subcategories:

2.2.1 Modular School

2.2.1.1 *Lego School*

2.2.1.2 *Ready to Race School*

2.2.2 Modular University

2.2.2.1 Lego University

2.2.2.2 Ready to Race University

This document describes the theme only for Category 1 – ***Indigenous Robot Category***

3 CONTEST STRUCTURE

The contest will consist of two stages:

1. Heats/Qualifying Rounds
2. Head to head matches

3.1 QUALIFYING ROUNDS

Each robot will participate in the qualifying rounds (heats). There will be no head-to-head matches in heats. For qualifying rounds following rules will be observed:

3.1.1 There will be NO head-to-head matches. Each team will individually run their robots.

3.1.2 Seeding chart will be based on points scored by teams. If the points of both teams are equal, decision will be made based on time taken by both teams. The team with shortest time will be placed on higher seed position. If time of both teams is also same, the decision

of the higher seed will be based on the shortest distance from the next objective from the current position (as per discretion of judges). If all the above criteria are the same, coin toss by judges will decide higher seed position.

3.1.3 Each team will be provided with a maximum of 4 minutes to run their robot. A timer will be displayed for the audience, however, accurate time through the stopwatch will be recorded by jury.

3.1.4 A team can take as many retries as desired within 4 minutes without any penalty but only the total time taken, and final score will be recorded. (Refer to the section 7.9, **Retry** for further details)

3.1.5 When a team takes a retry, the score is reset to zero and the entire arena will be reset.

3.1.6 When the team is ready, and the whistle is blown, then the time will start.

3.1.7 If a robot is not able to successfully complete the task in time, then the time when team's flag bearer will call it off (By saying "STOP") will be recorded as the finish time.

3.1.8 Only the **flag bearer** has the right to say **Retry/Stop.** Other members of the group must refrain from saying Retry/Stop other than the flag bearer to avoid confusing the referee. If referee makes a call due to the confusion caused by other team members, the referee's call will be considered final.

3.1.9 Judges reserve the right to give a re-run to any team with zero score with justifiable reason (if required). This clause will only be applicable if the Judges, Jury and Referee agree to the re-run. This clause does not apply to the team's request but to reasons which are justifiable and acceptable to the judging committee.

3.1.10 If the robot completes all tasks successfully and completely crosses the finish line (scoring maximum point), the stop called by the flag bearer will be of no importance/significance.

3.2 Head-to-head Matches

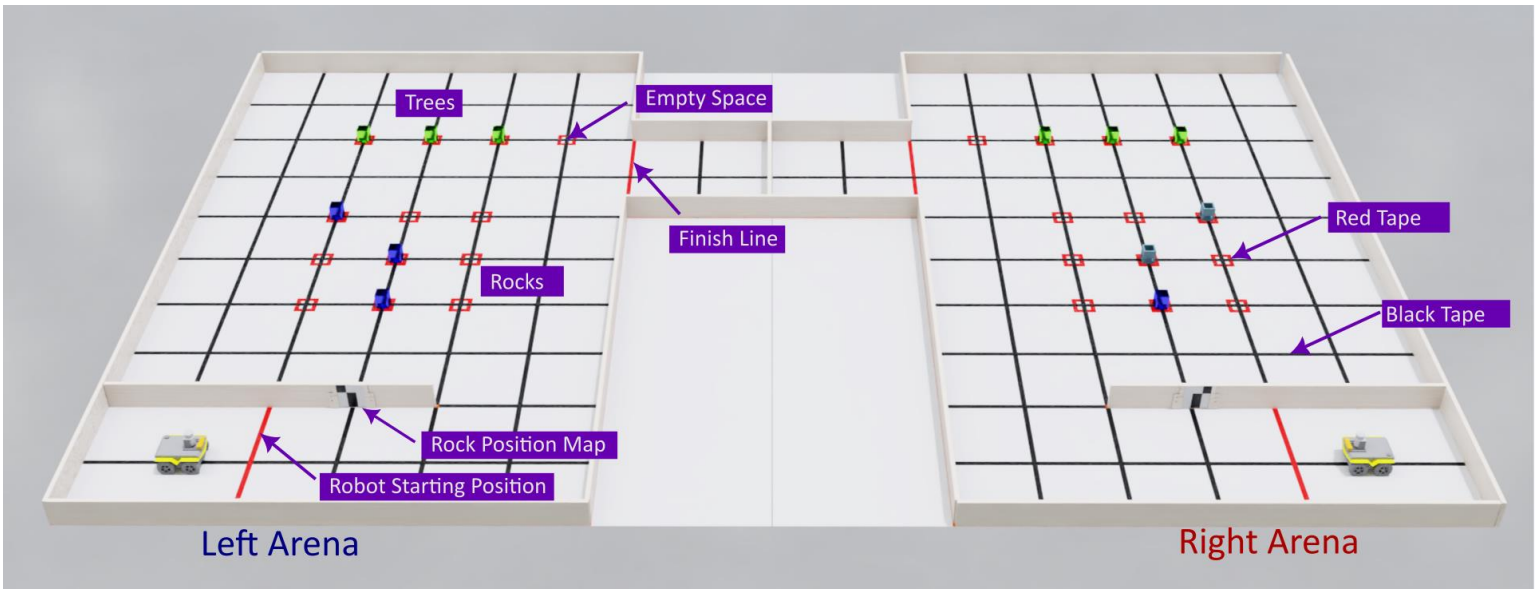
After qualifying rounds, the top 32 teams (with non-zero score) from the qualifying rounds will go for head-to-head matches. The judges reserve the right to change top 32 teams (the number of head-to-head matches). The winners will be decided through a final match and Runner-up will be decided based on the outcomes of the semifinals.

4 CONTEST THEME

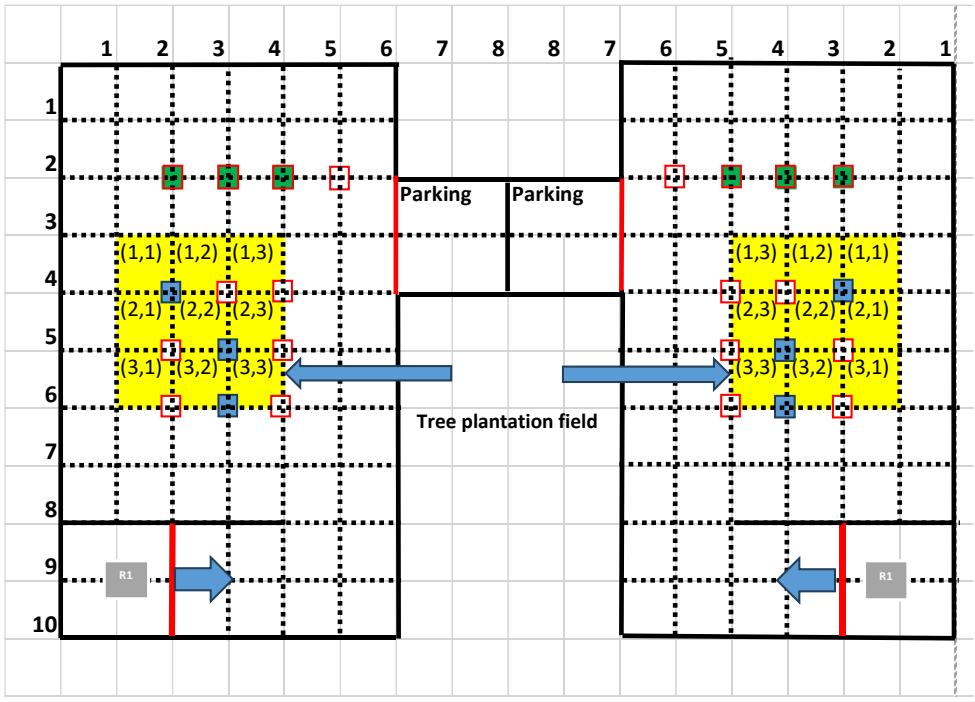
The NERC 2024 theme is based on automated tree plantation drive involving task planning and scheduling. In this theme, the task is to build an autonomous robot that will do tree plantation in a farm. The first job of the robot is to prepare the soil for tree plantation by removing rocks and pebbles from the soil. The robot will pick the rocks present in the field and dump the collected rocks into the designated areas on the farm. Afterward, the robot is to plant trees in the same locations where the soil is prepared by the robot. The first team to successfully place all the trees in their designated locations and reach the parking area will be declared the winner. The Contest Arena, depicting a complete farm where the tree plantation drive is to be conducted, is shown in Figure 1. Details are as follow:

1. Laminated wooden sheets (lasani) are used for the construction of the arena. The floor of arena will be of white color as shown in the map (Fig. 1). All the boundary walls and separation walls have a height of 5 inches throughout the arena. The solid line made with black tape of 3cm width (Dotted Line in Fig 1) present on the floor of arena can be used for line tracking. The entire arena is divided into 12x12 inch grids.
2. The starting position and orientation of the robots are fixed. The robot must be placed behind the starting line shown in Fig. 1 with red color. The complete robot should be behind the line. The red colored line is only for reference in Fig. 1, it will be a solid black colored line on actual arena.
3. There is a defined region in the farm called a “tree plantation field” where trees are to be planted (3x3 grid). The field is highlighted in Fig 1 with yellow color. Note that the yellow color and grid numbers are only visible in Fig. 1 for depicting the field region and are not present in the actual arena.
4. There will be a total of 3 rocks and 3 trees on the farm (detailed structure of rock and trees is given in Annex A, Fig. 2-5). Initially, rocks will be present within the field and trees will be present on one side of the farm as shown in Fig. 1. There are a total of 9 locations within the field where the rocks may be present. There are ten possible combinations of the three rocks placement in the field as given in Annex A. For each match, rock position map will be selected randomly from the ten possible combinations given in Annex A. However, for heats anyone of the ten rock positions will be fixed and announced before event.
5. To identify the exact location of the rocks, present in the field, a “rock position map” is mounted on the wall of the farm (Fig. 1) along the path from where the robot will pass after the start of the match. The rock position map is mounted on two locations, one on each wall i.e. the left and right-side walls of the robot's starting path (grid locations (10,3) and (8,3)). The robot may read the “rock position map” to identify the exact placement of rocks within the field. Details on the rock position map are given in Annex A. The Robot may follow the black line (Reflective Tape) or wall of the arena to locate the objects. Line/wall following is not compulsory, however the robot can’t go over the wall.

6. To identify the allowed regions for rocks and trees placement on the arena, a red-colored square box is present on all possible locations of the rocks and trees. The red color will be shown on the actual arena with red tape of 1-inch dimension. The dimension of the complete red square region will be 5x5 inches (including the dimension of tape). All rocks and trees are to be placed within this red-squared region. No part of the rock/tree should be outside the red-marked region. The black tape used to draw grids on arena will be pasted above the red tape. The dimensions of rocks and trees are given in Annex A.
7. The robot has the freedom to schedule the sequence of events i.e. to pick rocks and place trees. However, the placement of rocks/trees is to be done only at the defined locations of the farm.
8. The Tree/Rock should be placed within the marked area i.e. red tape box, such that when seen from above the red line should be visible on all four sides. It can be placed on the red line as long as some part of the red tape is visible. The definition of placement of rock/tree means that the object must be placed within the red bounding box and remain within the same box till the end of the match. If during operation, the object is displaced from the bounding box the placement marks shall be deducted.
9. The robot is allowed to place the tree/rock at any location in the arena during operation. However, marks will only be given when the object is placed in the designated area.
10. The number of rocks and trees may vary during the contest, there can be up to 3 Rocks and 3 trees.
11. The left and right-side arenas are mirror images of each other.
12. The team to successfully complete all tasks and reach the parking spot will be declared as the winner. A successful “reach” means all the parts of the robots have crossed the parking entrance line (represented with red color in Fig.1) and no part is on and above the line. The red colored line is only for reference in Fig. 1, it will be a solid black colored line on actual arena.
13. Dragging of rocks or trees is not allowed. The robot must pick the objects and place them at the designated area. However, while picking, if the rock/tree is slightly dragged that may be allowed as per the discretion of the judges. Constant dragging of the object till the end point is not allowed.
14. After the start of the match, the team cannot touch the robot. In case of a retry, the teams can reset their robots.
15. Each team must bring their own robot. The maximum dimension of the robot is 12x12 inches (LxW).
16. The robot should be an autonomous and indigenously developed robot.
17. The programming of the robot is allowed only in the setup time of around 1 minute, it is not allowed once a match has started.



(a)



(b)

Figure 1: Contest Arena (a) 2D view (b) top view

- *Each grid is of 12x12 inches.*
- *Both sides are mirrored images, the blue boxes are showing Rocks/Hurdles whereas trees are represented with green boxes.*
- *Solid Black lines are showing the height of 5 inches wall and dotted lines shows the black tape of 3cm width on arena.*
- *The highlighted yellow area is only for reference, the tree plantation field will have white background like the rest of the arena.*

5 ROBOT OPERATION

The qualifying teams (those which qualify for the final rounds) will compete with each other in a knockout format. In each match two teams will be pitted against each other, running their robots side by side in the contest arena. Teams will be declared as Team A or Team B based on the coin toss before every match. The winner of coin toss will decide which arena to choose i.e. Left Arena or Right Arena. The left arena will be given a Blue flag while the right arena will be given a Red flag, hence the arena may be referred to as the Red or Blue arena.

Once turned on, the robot must be self-controlled without any human intervention and contestants are NOT allowed to touch their robots. After the blow of a whistle, the robot will have 4 minutes to complete the task.

During a retry, the layout of the arena shall remain SAME and shall be reset, however the point-scoring will restart from zero. The robot may navigate through the arena using any suitable technique. The robot may not displace any un-authorized item in the arena. Displacing any un-authorized item inside the arena will result in a forced retry or disqualification as per discretion of judges (Judges decision on declaring a displacement will be final). If the participating team sees that their robot has lost track of its location and is facing trouble localizing itself, the team can ask for a retry by raising their flag. During its motion, the robot may touch the walls of the arena without damaging them, but it is not allowed to use any sort of tactile sensor to sense the walls. This will result in forced retry as per call of referee or disqualification as per discretion of judges.

In case of a tie, the contestant may be required to run a rematch, or the winner may be decided on a coin toss as per the discretion of the judges.

For a particular match, both teams will face the same layout of the arena.

6 POINTS

The point scoring is shown below in Table 1 Point Scoring.

Table 1 Point Scoring

Point Scoring:	**Score**
Picking of Rocks	**3x5=15**
**Placement of Rocks	**3x10=30**
Picking of Trees	**3x5=15**
**Placement of Trees	**3x10=30**
*Reaching the Exit Point	**10**
Total	**100**

[Note: Picking and placing points can only be awarded once per object "Rock/Tree"]

*Reaching means the robot must have completely crossed the Finish line and entered the parking Area.
**The Tree/Rock should be placed within the designated area marked by the red box (as per position map) such that the red line/part of line is visible on all four sides when observed from the top. The marks will not be allotted for placement if the red lines are not visible on all four sides.

6.1 DEDUCTION OF POINTS

The deduction of points is shown below in Table 2. Deduction of Points

Table 2. Deduction of Points

Deduction/Penalty	
The robot fits in an area of 12x 12-inch square	No Penalty
Oversize Robot (14x14 inch square)	5 Points
Oversize Robot (exceeding 14 x 14-inch square)	Disqualification
Robots weighs less than 12 kg*	No Penalty
Overweight Robots (Weight between 12 and 14 kg)	5 Points
Overweight Robots (Weight exceeding 14 kg)	Disqualification
Damaging the arena/wall/sites/Tape/Objects	Disqualification

*This is the individual weight of each robot

The penalty handicap shall be applicable in heats and head to head matches.

7 RULES

The following are the rules governing the contest.

7.1 GENERAL

7.1.1 The Contest judges may stop any robot at any time if they feel that it is performing or is about to perform any action that is dangerous or hazardous to people or equipment.

7.1.2 All electronic circuits must be designed and fabricated by the contestants themselves.

7.1.3 Maximum effort in the design and fabrication of the robot shall be done by the contestant themselves.

7.1.4 Contestants are allowed to use only certain electronic components, list for which is attached at the end of this document.

7.1.5 Additional information regarding the contest rules and regulations may be found in the Tab of FAQs(https://nerc.ceme.nust.edu.pk) and will be considered as part of the theme and rules. New FAQs are uploaded frequently so keep watching the FAQ corner for new information.

7.1.6 Any correspondence with the NERC officials via e-mail, telephone or any other means will not be considered as part of the rules (unless uploaded as an FAQ on official NERC (website). It is the responsibility of each contestant to be familiar with all the rules.

7.1.7 If both the teams have scored same points but are not able to complete the task in allocated time slot, decision of the winner will be on judges' discretion who will determine which robot is closer to finish the task first.

7.1.8 If both teams have scored the same points, have the same time and are at the same distance from the finish point, a coin toss will be used to decide the winner.

7.1.9 If any team wants to launch a protest (of any kind), they must do so within 15 minutes after the end of their match. The procedure and payment are outlined in Annex C.

7.1.10 Attempting to damage the game field or performing an act that fails to comply with the spirit of Fair Play will lead to the disqualification of the team.

7.1.11 In all matters of interpreting the rules before and during the Contest and for any issues not covered by these rules, the decisions of the Contest Judging Committee will be final.

7.1.12 Wireless Control of the Robot for operation is not allowed.

7.2 TEAMS

7.2.1 The Robots can be built by teams of currently registered students from Engineering Institutions and Polytechnic Institutions. Each team can comprise of a ***maximum of 6 members***.

7.2.2 If the students from two different Institutes/Universities join hands and form a team in collaboration, then the name of the Institute/University with maximum number of students in such a team would be registered or official consent from both institutions will be required at the time of registration before the contest start date.

7.2.3 A person can't participate in more than two teams.

7.3 ROBOT SIZE AND WEIGHT

The robot fits within 12x 12-inch square at the time of measurement. If the area of the robot base is more than 12x 12-inch square but less than 14 X 14- Inch square, then points will be deducted. There is no restriction on the maximum permissible height of the robot. Any robot which does not fit in 14 X 14-Inch square will be disqualified. All robots will be carefully measured. All sensors mounted on the robot will be counted as part of the robot's total dimensions. If contestants want to add a flag, hat or other purely decorative, non-functional items to the robot, they may do so. The decorations may be removed for measurement purposes. The weight of each robot excluding decorations must not exceed 12 kg. Penalties are as detailed in 6.1 Deduction of Points will be levied if the robot does not fulfill the size and/or weight criteria.

7.4 ROBOT OPERATION

7.4.1 Any team that damages the arena will be disqualified.

7.4.2 The robot must not use any harmful substances such as oil, petrol etc. in its operation that can damage the arena.

7.4.3 The Robot CANNOT split after the start of the game, only one Robot is allowed to compete at a time.

7.4.4 The robot must not use any destructive or dangerous methods to displace any obstacle or box.

7.5 SENSORS

7.5.1 Robot is not allowed to use tactile sensor of any type for sensing the walls.

7.5.2 Ultra-Sonic Range detectors (SONARs) or IR based proximity sensors (models specified in the components' list attached) can be used for sensing walls/Line.

7.5.3 The team may use any off-the-shelf encoders if they feel the necessity. Self-made encoders from discrete components are also allowed.

7.6 ELECTRONICS

7.6.1 All electronic circuitry must be designed and fabricated completely by the participants themselves. Circuits should not be fabricated by the help of any professional developers. Only the modules specified in the components list may be bought directly.

7.6.2 The participants must not use any pre-fabricated board or electronic circuitry. Any type of the electronic board or circuit must be etched by the students themselves. Circuits should not be fabricated by the help of any professional developers.

7.6.3 Microcontrollers specified in the components list must be used for controlling your robots. You can also use Microcontroller development boards specified in the list only. Microprocessors and Single Board Computers are not allowed.

7.6.4 Motor drive circuits should be designed and fabricated by participants themselves and made from discrete components like Transistors and logic circuitry. H-bridge IC's like L297 or L298 are not allowed. However, you may use Gate driver IC's e.g. IR2101/IR2110 etc. This clause is for the robot drive motors only. The lifting mechanism motor can be controlled using H-bridge IC's.

7.6.5 No prefabricated modules are allowed, unless listed in the components list (Annex A) or allowed by the NERC coordinator. If a component needs to be added then all of its specifications (datasheet, picture, location to purchase, price) MUST be emailed for formal permission.

7.6.6 All other components can be used in your circuitry. In case of any query, questions shall be emailed to NERC Coordinator at nerc@ceme.nust.edu.pk . The FAQs section on the website shall be considered part of the theme.

Note: Only the theme documents and the questions in the FAQ section of the official website (nerc.ceme.nust.edu.pk) shall be considered as official notifications.

7.7 POWER SUPPLY

7.7.1 The robot must be battery-powered.

7.7.2 The robot must not have any wired connections with its surroundings.

7.7.3 Voltage of the machine's electrical power source must not exceed 48-volt DC. **Power banks may be used.**

7.7.4 Power sources that are considered dangerous or unsuitable by the contest officials shall not be permitted.

7.8 DURATION OF MATCH

7.8.1 Each match will be of maximum 4 minutes.

7.8.2 Teams will be given around 1 minute for setting up the Robot at the start.

7.8.3 Robots can start at the instant when the start signal is given, and a whistle is blown. The Robot should be constructed so that it can be started in minimum possible steps.

7.8.4 Once the Robot moves, team members will not be allowed to touch the Robot or enter the Contest Arena. If any team member enters, forced retry shall be imposed.

7.8.5 Timing shall start once the start signal is given and the whistle is blown.

7.8.6 Time would be stopped as soon as Robot reaches completely into the parking spot. If a robot is not able to successfully complete the task, then the time when team will call it off (by the flag bearer saying STOP", will be recorded as the finish time. The team must leave their robots as they are on their current locations when time stop is called by them. They are NOT allowed to pick their robots up till the referee announces the end of the match. The team is not allowed to take a retry after the time has stopped or STOP has been called.

7.8.7 The team which picks all the rocks and replaces them with trees, then reaches the parking spot will be declared the winner of the match.

7.8.8 If both teams fail to complete the task, within the time limit, the team scoring more points will be declared the winner of the match.

7.8.9 If both the teams have scored the same points but are not able to complete the task in the allocated time slot, then winner will be decided on time. If both teams call stop at same time, then decision of the winner will be on judges' discretion who will determine which robot is closer to finish the task first. The distance of the robot's current location from the Finish Point (Parking Spot) will be measured.

7.8.10 The Complete robot is required to cross the parking line for the run to terminate.

7.9 RETRY

If the robot is strayed due to some reason, retries are allowed.

7.9.1 There is no limitation on the number of retries and a team can take as many retries within the 4 minutes duration of the match. No Points will be deducted for retries but total score will reset to zero.

7.9.2 Each team would be provided with a flag of their respective team. If a team wants to take a retry, the flag bearer must raise the flag and say clearly "retry". Once the referee announces a retry, the team shall place its robots at their starting location.

7.9.3 If a team wants to stop their robot during the match, the flag bearer must raise the flag and say “stop”. The team can then turn off their robot, but they must not move it. The time at which the robot is stopped would be recorded as the final time. The team must not enter the arena until referee has acknowledged the “STOP”.

7.9.4 For each retry, robots must be started again from the start point. Points will reset to zero.

7.9.5 Arena Management team is responsible to reset the arena, any team member is not allowed to interfere or do the resetting of arena themselves. If such an act is done, referee will call retry.

7.9.6 Separate time for individual retries will NOT be recorded or maintained. When a team takes a retry, it is only allowed to restart the robot.

7.9.7 Once the start whistle is blown, the team can’t reprogram their robot.

7.9.8 If the contestants enter the arena during the match, it will automatically be counted as a retry.

7.9.9 Once the stop has been called by the flag bearer or the task has been completed (obtained full marks), retry will not be allowed.

7.9.10 Only the **flag bearer** has the right to say **Retry/Stop.** Other members of the group must refrain from saying Retry/Stop other than the flag bearer to avoid confusing the referee. If referee makes a call due to the confusion caused by other team members, the referee’s call will be considered final.

7.10 **DISQUALIFICATION**

The following behavior shall be considered for disqualification by the referee and the team could possibly be disqualified:

7.10.1 Attempting to damage the game field.

7.10.2 Performing any act that fails to comply with the spirit of Fair Play.

7.11 **PROTEST PROCEDURE**

The protest procedure is as follows:

7.11.1 The team must launch a protest (submit a complete protest form to the head jury) within 15 minutes after the end of their match.

7.11.2 The team must collect the protest form from the head jury on request or use a hard copy of the form in Anx C.

7.11.3 The team must submit a non-refundable protest fee of Rs. 5000/- along with the protest form.

7.11.4 A complete protest form includes submission of the protest fee.

7.11.5 The head jury will forward the case to the judges.

7.11.6 The judges will decide on the protest's validity and render their decision.

7.11.7 In case of noncompliance of any of points above, the protest will not be considered valid.

7.11.8 The judges' decision will be final.

8 TEST RUN

Contestants will be given time for trial run one day before the contest to calibrate their robot/sensors on the actual arena/game field. However, considering the huge numbers of participants, practice time may be limited. Scheduling shall be done by the organizers.

Annex A: Rock Position Map

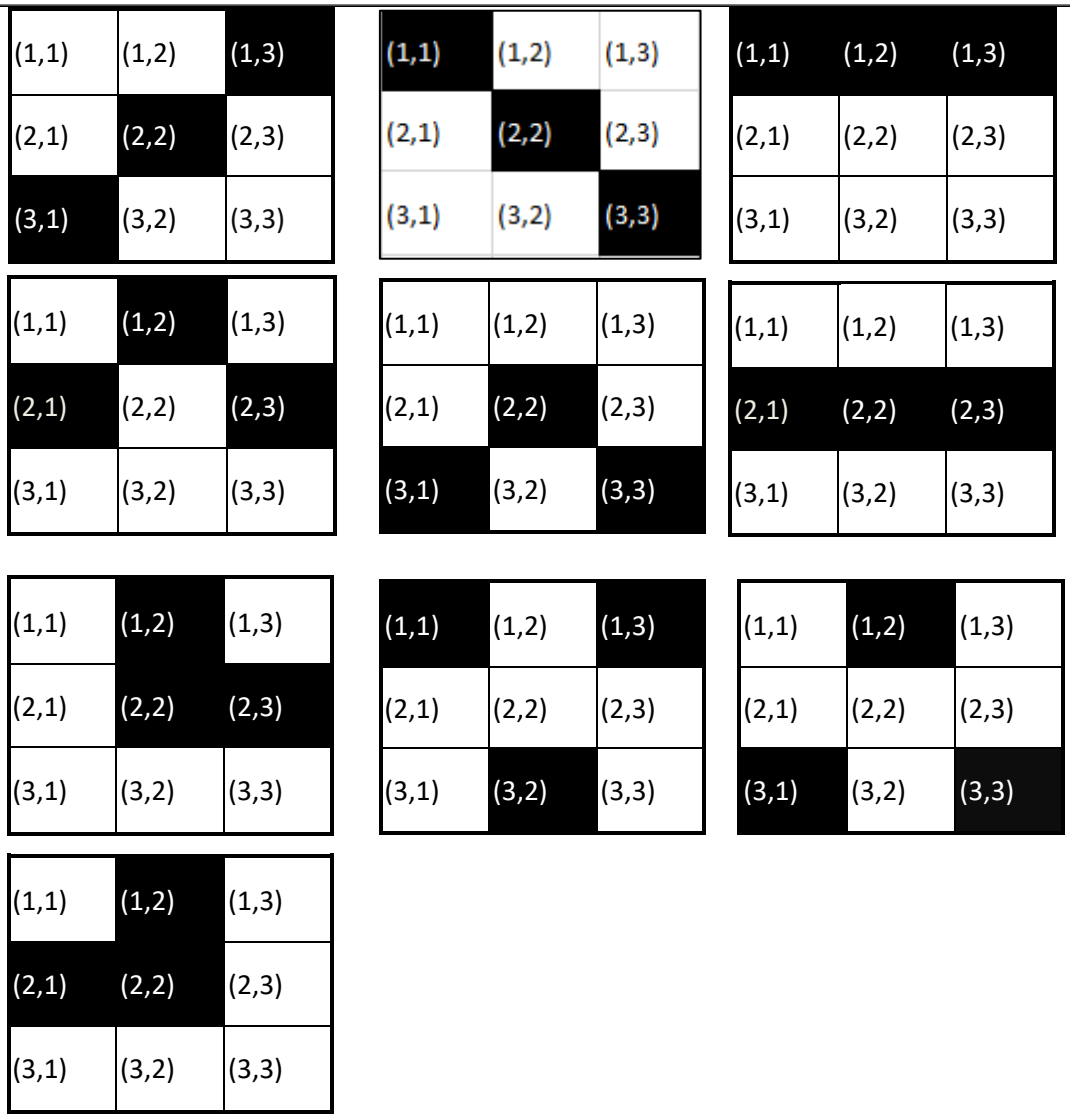
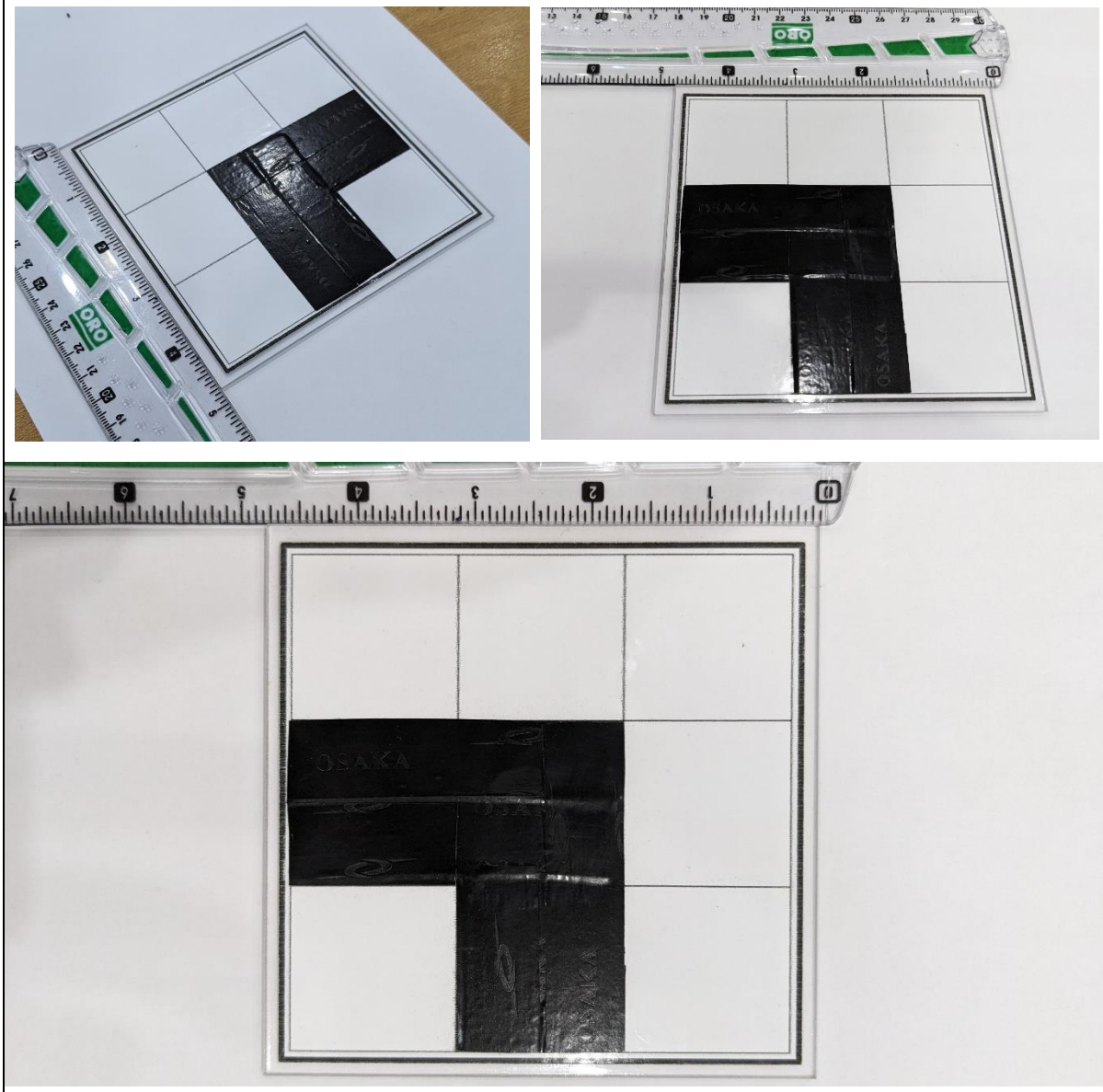


Figure 2. Ten possible combinations of rocks placement in field

- The dimensions of the Rock position map are 4.5 x 4.5 inches.
- Each cell has a dimension of 1.5 x 1.5 inches.
- There are 9 possibilities against the position of each Rock.
- The black cells depict the location of rocks within field.
- Refer to Figure1 for the respective position on arena.
- The coordinates shown above are only for reference.



- Images of Rock Position map
- Rock Position map is printed on stickers and sticked onto transparent acrylic plates.
- Black electric tape is placed on black matrix (Rock Position) for better sensor detection.

Figure 3. Details of Rock Position Map

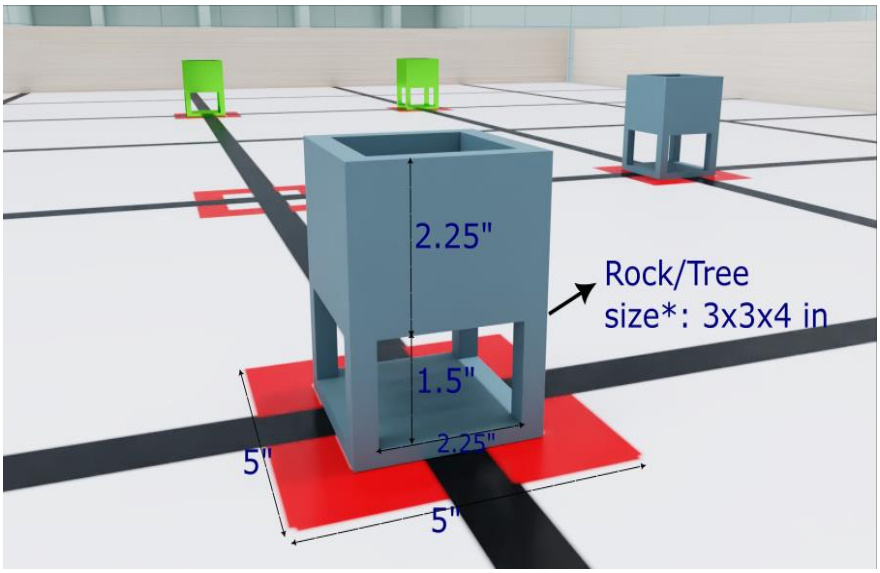
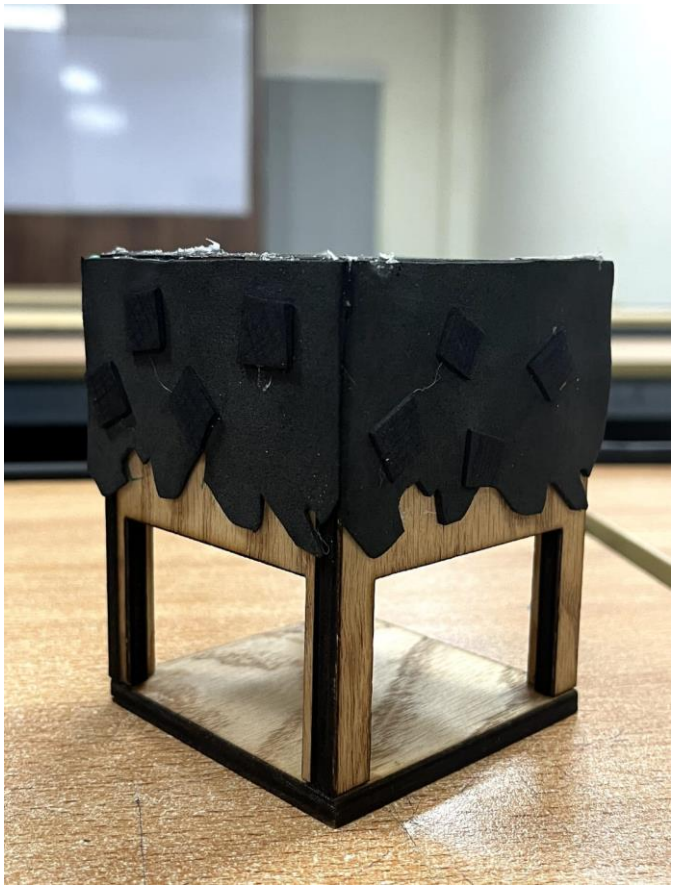
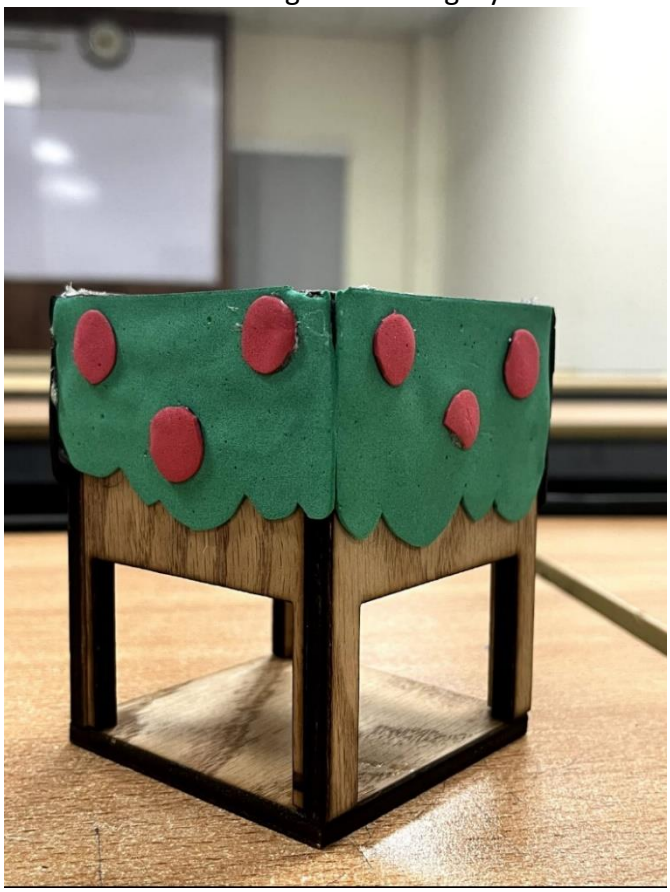


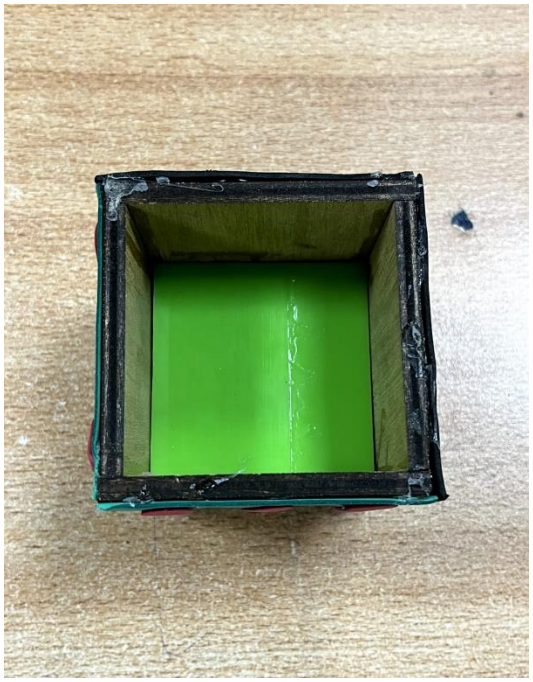
Figure 4: Rock/Tree Dimensions



(a) Rock



(b) Tree



(c) Top View of tree

Figure 5: Decorative cover to represent rock/tree boxes (a) rock, (b) tree and (c) top view of tree

Annex B: COMPONENTS LIST

Please see the components below. In case of any query, questions shall be emailed to NERC Coordinator at nerc@ceme.nust.edu.pk . The FAQs section on the website shall be considered part of the theme.

Table 3 Components List

Sensors	***Allowed Parts***
Wall Following Sensor (Proximity Sensors)	1) IR Sensors: Sharp GP2Dxx & GP2Y0xx series sensor 2) Sonars: Maxbotix Maxsonar Range Finder series (XL,LV) Parallax PING))) Ultrasonic sensor, HC-SR04 3) Self-made from discrete components
Colour Sensor	1) ADJD-S371-QR99 RGB sensor 2) Self-made from discrete components 3) TCS230 or TCS3200
Other Sensors	1) Compass/Magnetometer: HMC5883L 2) IMU: MinIMU-9 v3 Gyro Accelerometer and Compass (L3GD20H and LSM303D), MPU-6050 Accelerometer + Gyro 3) IMU: GY-80 ADXL345 Accelerometer 4) Accelerometer : ADXL345 5) Gyro: LPR550AL Dual-Axis (Pitch and Roll or XY) Gyro ,LPR550AR Dual-Axis (Pitch and Roll or XY) Gyro

Microcontroller ***Note: No wireless add on can be connected with the controller.***	1) PIC16F/PIC18F family 2) AVR ATTiny, ATMega, 3) 8051, 8052, 8055

Development Boards	1) Arduino Mega, Uno, Nano, mini, Pro Series, Leonardo, Esplora, Due 2) Pinguino 26j50 3) Amicus 18 4) Raspberry Pi Model B, model A, Pi zero (non W) Note: **Only those Development Boards are allowed which don't have Built in Wi-Fi** or any external Wi-Fi module is not allowed
External Shields	*Only SD card shield allowed*
Motor driver	*Self-made from discrete components for drive motors.* *H-Bridge ICs are allowed **ONLY** for lifting mechanism motors.*
Motor	*Maximum 2 motors are allowed for the drive purpose There is no limitation of number of motors in mechanism. Encoders are allowed*
Battery	*Any type (Power Banks are allowed)*
Wheels	*Meccanum/Omni wheels are not allowed*
IR Sensor	*BRD1000 Array Sensor*
Free Wheels	*The following free wheels are allowed:* *https://electrobes.com/product/nylon-caster-wheel-free-moving-for-robotic-car/* *https://electrobes.com/product/metal-ball-caster-wheel-20mm-metal-ball-for-robotic-car/*

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Protest Form

Team Name:	
Team ID:	
Team University:	
Team Members:	
Match finish time (to be filled by Head Jury)	
Launch time of Protest (to be filled by the head jury)	
Protest fee Payment (to be filled by head jury)	

Reason of Protest: _____

_____

_____

_____

_____ _____

Signature of Team Leader Signature of Head Jury

Decision of Judges: _____

_____

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Signature of Head Judge